Project Introduction

NASA has a critical requirement for a neurodiagnostic tool that can be used to monitor the behavioral health of the crew during long duration exploration missions. The device should unobtrusively monitor and classify neurophysiological markers associated with decrements in behavioral state and cognition. The neurodiagnostic monitor should be lightweight and compact and should require minimal time or effort for the crew to use. The device should be unobtrusive enough to allow mission operations to be performed during monitoring. In Phase 1 of the program, we were able to successfully monitor cortical activity using multi-parameter sensor modules. In addition to electroencephalography (EEG) and functional near infrared spectroscopy (fNIRS) signals that provided the electrophysiological and cortical oxygenation information, we were able to obtain photoplethysmography (PPG) and electrooculography (EOG) signals to compute the heart rate and frequency of eye movement. In Phase 1 we also demonstrated the functionality of an algorithm that automatically classifies the varying degrees of cognitive loading based on the measured physiological parameters. In the proposed Phase 2 program, we will develop a flight-capable neurodiagnostic device that can be unobtrusively worn on the head. Based on the neuro and non-neurophysiological parameters obtained from the multi-modality sensors, we will detect and classify neurophysiological markers associated with decrements in behavioral state and cognition. We will develop an automated algorithm that can recognize and identify key decrements in behavioral state.

Primary U.S. Work Locations and Key Partners

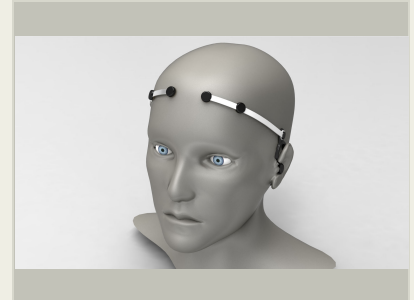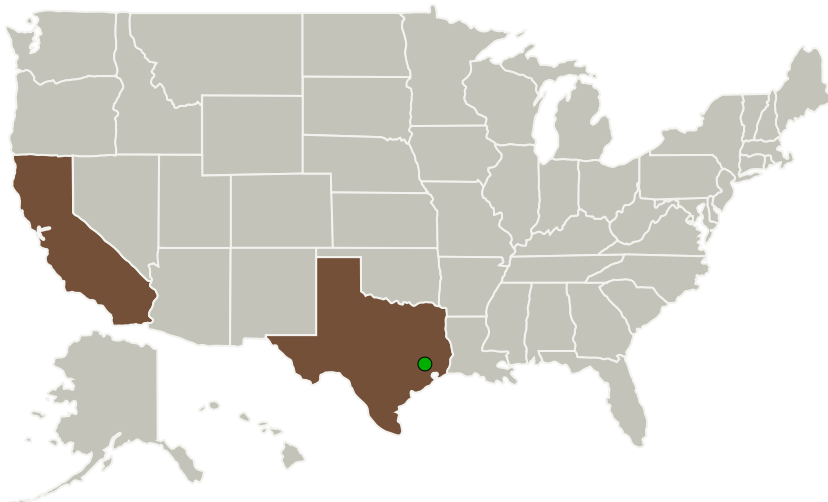Multi-Modal Neurodiagnostic Tool for Exploration Missions

Table of Contents

Organizations Performing Work	Role	Type	Location
Linea Research Corporation	Lead Organization	Industry	Palo Alto, California
🟢Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations	
California	Texas

Project Transitions

▶ **December 2012:** Project Start

✔ **December 2014:** Closed out

    Closeout Documentation:
- Final Summary Chart*(https://techport.nasa.gov/file/137344)*

Images

Project Image
Multi-Modal Neurodiagnostic Tool for Exploration Missions
(https://techport.nasa.gov/image/136178)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Linea Research Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management
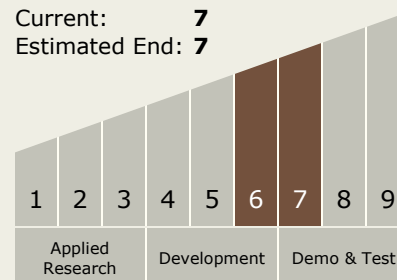
Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Yongjin Lee

Technology Maturity (TRL)

Start: **6**
Current: **7**
Estimated End: **7**

1	2	3	4	5	6	7	8	9
Applied Research			Development		Demo & Test			

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  └ TX06.3 Human Health and Performance
    └ TX06.3.1 Medical Diagnosis and Prognosis

Target Destinations
The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System